CLAIMS

What is claimed is:

1. A method, comprising extending a digital subscriber loop including:

producing an output signal from first variable gain amplifier responsive to an input signal from said digital subscriber loop;

monitoring a signal strength of said output signal;

generating a gain control signal responsive to said signal strength; and

controlling a gain of said variable gain amplifier responsive to said gain control signal.

2. The method of claim 1, wherein said input signal originates from a customer-premise side of said digital subscriber loop.

3. The method of claim 1, wherein said input signal originates from a central office side of said digital subscriber loop.

4. The method of claim 1, further comprising controlling another gain of another variable gain amplifier responsive to said gain control signal.

5. The method of claim 1, further comprising controlling another gain of another variable gain amplifier responsive to another gain control signal, the another gain control signal generated in response to another signal strength of another output signal from another variable gain amplifier.

6. The method of claim 1, wherein monitoring includes monitoring said signal strength using a peak detector circuit.

7. The method of claim 1, wherein generating said gain control signal includes generating said gain control signal using an automatic gain control loop filter.

8. The method of claim 1, wherein controlling gain of said variable gain amplifier includes

choosing one of eight discrete values of gain.

9. The method of claim 1, wherein controlling gain of said variable gain amplifier includes choosing one of four discrete values of gain.

10. The method of claim 1, wherein controlling gain of said variable gain amplifier includes choosing one of two discrete values of gain.

11. The method of claim 1, further comprising detecting whether a downstream signal is present on said digital subscriber loop.

12. The method of claim 11, wherein controlling said gain includes determining when to change said gain based on at least one elapsed time interval selected from the group consisting of Tnormal, Tshutdown, Tsleep, and Tdead.

13. The method of claim 11, wherein controlling said gain includes changing said gain within a range defined by an upper limit and a lower limit if said downstream signal is not present, said gain control signal is below a low threshold, and a time interval Tdead has elapsed.

14. The method of claim 11, wherein controlling said gain includes increasing said gain if said downstream signal is present, said gain control signal is below a low threshold, and a time interval Tup has elapsed.

15. The method of claim 11, wherein controlling said gain includes decreasing said gain if said downstream signal is present, said gain control signal is above a high threshold, and a time interval Tdown has elapsed.

16. The method of claim 11, wherein controlling gain includes forcing a link termination.

17. The method of claim 11, wherein controlling said gain includes reestablishing a link.

18. A method, comprising:

controlling a repeater to operate in a downstream direction using a first variable gain amplifier coupled to a first controller, said first variable gain amplifier having a first gain, said first controller having a first peak detector and a first loop filter, said first gain controller providing a first output signal having a first signal strength, said first peak detector monitoring said first signal strength of said first output signal, and said first loop filter generating a first gain control signal, said first gain control signal feedback to said first variable gain amplifier to automatically adjust said first gain of said first variable gain amplifier; and

controlling said repeater to operate in an upstream direction using a second variable gain amplifier coupled to a second controller, said second variable gain amplifier having a second gain, said second controller having a second peak detector and a second loop filter, said second controller providing a second output signal having a second signal strength, said second peak detector monitoring said second signal strength of said second output signal, and said second loop filter generating a second gain control signal, said second gain control signal feedback to said second variable gain amplifier to automatically adjust said second gain of said second variable gain amplifier.

19. The method of claim 18, wherein generating said first gain control signal includes establishing a first control voltage as a function of said first signal strength of said first output signal, and generating said second gain control signal includes establishing a second control voltage as a function of said second signal strength of said second output signal.

20. A method, comprising:

splitting a transmission medium at a point between a first end and a second end to deploy a repeater circuit, said repeater circuit having a first variable gain amplifier and a second variable gain amplifier, said first variable gain amplifier having a first gain and said second variable gain amplifier having a second gain;

coupling said repeater circuit to said transmission medium;

providing an output signal from said first variable gain amplifier, said output signal having a signal strength as a function of said first gain;

utilizing a controller coupled to both said first variable gain amplifier and said second variable gain amplifier, said controller having a peak detector coupled to a loop filter, said peak

detector monitoring said signal strength of said output signal, and said loop filter generating a gain control signal, said gain control signal feedback to both said first variable gain amplifier and said second variable gain amplifier;

automatically controlling said first gain of said first variable gain amplifier responsive to said gain control signal while transmitting a first communication in said first direction, said first communication within a first frequency range, over said transmission medium from said first end to said second end; and

automatically controlling said second gain of said second variable gain amplifier responsive to said gain control signal while transmitting a second communication in said second direction, said second communication within a second frequency range, over said transmission medium from said second end to said first end.

21. The method of claim 20, wherein generating said gain control signal includes establishing a control voltage as a function of said signal strength of said output signal.

22. An apparatus, comprising a digital subscriber loop extender circuit including:

a variable gain amplifier having a gain and providing an output signal in response to an input signal from a signal generator over a transmission medium, said output signal having a signal strength as a function of said gain; and

a controller coupled to said variable gain amplifier, said controller generating a gain control signal that is feed back to said variable gain amplifier to automatically control said gain.

23. The apparatus of claim 22, further comprising another variable gain amplifier coupled to said controller, the another variable gain amplifier having another gain and providing another output signal in response to another input signal from another signal generator over said transmission medium, the another output signal having another signal strength as another function of the another gain.

24. The apparatus of claim 22, further comprising

another variable gain amplifier coupled to said controller, the another variable gain amplifier having another gain and providing another output signal in response to another input

signal from another signal generator over said transmission medium, the another output signal having another signal strength as another function of the another gain; and

another controller coupled to the another variable gain amplifier, the another controller generating another gain control signal that is feed back to the another variable gain amplifier to automatically control the another gain.

25. The apparatus of claim 22, wherein said controller includes a peak detector and a loop filter, said peak detector monitoring said signal strength of said output signal, and said loop filter coupled to said peak detector to generate said gain control signal, said gain control signal feedback to said first variable gain amplifier for automatically controlling said first gain, and said gain control signal feedback to said second variable gain amplifier for automatically controlling said second gain.

26. The apparatus of claim 22, further comprising said signal generator, wherein said signal generator includes a discrete multi-tone asymmetric digital subscriber loop transmission unit.

27. The apparatus of claim 22, further comprising said transmission medium, wherein said transmission medium includes an asymmetric digital subscriber loop.

28. The apparatus of claim 22, wherein said digital subscriber loop extender circuit is interposed at an intermediate point of said asymmetric digital subscriber loop to extend said asymmetric digital subscriber loop, wherein said intermediate point lies between a provider end and a subscriber end.

29. The apparatus of claim 28, wherein said intermediate point is flexibly located by splitting said asymmetric digital subscriber loop into a first portion and a second portion, said first portion defining a first loop length between a central office end and said digital subscriber loop extender and said second portion defining a second loop length between said digital subscriber loop extender and said subscriber end, wherein said gain is a function of said second loop length.

30. The apparatus of claim 22, wherein said variable gain amplifier includes a voltage-controlled amplifier chain.

31. An apparatus, comprising:

a repeater circuit having a first variable gain amplifier to amplify a first direction communication and a second variable gain amplifier to amplify a second direction communication, said first variable gain amplifier having a first gain, said second variable gain amplifier having a second gain, said first variable gain amplifier providing a first output signal in response to a first input signal from a first signal generator over a transmission medium, said first output signal having a first signal strength as a function of said first gain, and said second variable gain amplifier providing a second output signal in response to a second input signal from a second signal generator over said transmission medium, said second output signal having a second signal strength as a function of said second gain;

a first controller coupled to said first variable gain amplifier, said first controller including a first peak detector and a first loop filter, said first peak detector monitoring said first signal strength of said first output signal, and said first loop filter coupled to said first peak detector to generate a first gain control signal, said first gain control signal feedback to said first variable gain amplifier for automatically controlling said first gain; and

a second controller coupled to said second variable gain amplifier, said second controller including a second peak detector and a second loop filter, said second peak detector monitoring said second signal strength of said second output signal, and said second loop filter coupled to said second peak detector to generate a second gain control signal, said second gain control signal feedback to said second variable gain amplifier for automatically controlling said second gain.

32. The apparatus of claim 31, wherein said repeater circuit includes an asymmetric digital subscriber loop repeater.

33. The apparatus of claim 31, wherein said first variable gain amplifier includes a first voltage-controlled amplifier chain and said second variable gain amplifier includes a second voltage-controlled amplifier chain.

34. An apparatus, comprising:

an asymmetric digital subscriber loop repeater circuit having a first voltage-controlled

variable gain amplifier to amplify a first direction communication and a second voltage-controlled variable gain amplifier to amplify a second direction communication, said first voltage-controlled variable gain amplifier having a first gain, said second voltage-controlled variable gain amplifier having a second gain, said first voltage-controlled variable gain amplifier providing a first output signal in response to a first input signal from a first signal generator over said asymmetric digital subscriber loop, said first output signal having a first signal strength as a function of said first gain, and said second voltage-controlled variable gain amplifier providing a second output signal in response to a second input signal from a second signal generator over said asymmetric digital subscriber loop, said second output signal having a second signal strength as a function of said second gain;

a first automatic gain controller coupled to said first voltage-controlled variable gain amplifier, said first automatic gain controller including a first peak detector circuit and a first loop filter circuit, said first peak detector circuit monitoring said first signal strength of said first output signal, and said first loop filter circuit coupled to said first peak detector circuit for generating a first gain control voltage signal, said first gain control voltage signal feedback to said first voltage-controlled variable gain amplifier to automatically control said first gain; and

a second automatic gain controller coupled to said second voltage-controlled variable gain amplifier, said second automatic gain controller including a second peak detector circuit and a second loop filter circuit, said second peak detector circuit monitoring said second signal strength of said second output signal, and said second loop filter circuit coupled to said second peak detector circuit for generating a second gain control voltage signal, said second gain control voltage signal feedback to said second voltage-controlled variable gain amplifier to automatically control said second gain.

35. The apparatus of claim 34, wherein said asymmetric digital subscriber loop repeater circuit is interposed at an intermediate point of said asymmetric digital subscriber loop to extend said asymmetric digital subscriber loop, wherein said intermediate point lies between a provider end and a subscriber end.

36. The apparatus of claim 35, wherein said intermediate point is flexibly located by splitting said asymmetric digital subscriber loop into a first portion and a second portion, said first portion

defining a loop length between said asymmetric digital subscriber loop repeater and said subscriber end.

37. A method, comprising:

controlling an asymmetric digital subscriber loop repeater to operate in a downstream direction using a first voltage-controllable variable gain amplification interface coupled to a first automatic gain controller, said first voltage-controllable variable gain amplification interface having a first gain, said first automatic gain controller having a first peak detector and a first loop filter, said first voltage-controllable variable gain amplification interface providing a first output signal having a first signal strength, said first peak detector monitoring said first signal strength of said first output signal, and said first loop filter generating a first gain control signal, said first gain control signal feedback to said first voltage-controllable variable gain amplification interface for automatically adjusting said first gain of said first voltage-controllable variable gain amplification interface used for said downstream direction; and

controlling said asymmetric digital subscriber loop repeater to operate in an upstream direction using a second voltage-controllable variable gain amplification interface coupled to a second automatic gain controller, said second voltage-controllable variable gain amplification interface having a second gain, said second automatic gain controller having a second peak detector and a second loop filter, said second voltage-controllable variable gain amplification interface providing a second output signal having a second signal strength, said second peak detector monitoring said second signal strength of said second output signal, and said second loop filter generating a second gain control signal, said second gain control signal feedback to said second voltage-controllable variable gain amplification interface for automatically adjusting said second gain of said second voltage-controllable variable gain amplification interface used for said upstream direction.

38. The method of claim 37, further comprising deploying said asymmetric digital subscriber loop repeater at an intermediate point of said asymmetric digital subscriber loop, wherein said intermediate point lies within a predetermined range between a provider end and a subscriber end.

39. The method of claim 38, wherein said intermediate point is flexibly located by splitting said asymmetric digital subscriber loop in a first portion and a second portion, said first portion defining a loop length between said asymmetric digital subscriber loop repeater and said subscriber end, said loop length is not known a priori.

40. The method of claim 38, further comprising deploying another asymmetric digital subscriber loop repeater at another point of said asymmetric digital subscriber loop, wherein the another asymmetric digital subscriber loop repeater provides automatic gain control.

41. The method of claim 38, further comprising deploying another asymmetric digital subscriber loop repeater at another point of said asymmetric digital subscriber loop, wherein the another point lies within a predetermined range of at least one of member selected from the group consisting of said provider end, said subscriber end, and said intermediate point.